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(54) **RADAR SYSTEM**

RADARSYSTEM

SYSTÈME RADAR

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Description

FIELD

[0001] The present disclosure relates to a radar system comprising a transmitting element, a receiving element and a radome.

BACKGROUND

[0002] A radar system may comprise a device called radome which is located as a cover in front of antennas of the radar system in order to protect the antenna from the environment, i.e. as a protection against dust, moisture, etc. Usually, such a radome is a flat structure above an antenna of the radar system in order to maintain the same electrical length for transmission over incident angles for all antennas of the radar system.

[0003] However, the radome may lead to an undesired mutual coupling between transmitting antennas and receiving antennas of the radar system. This coupling is due to the energy originating from reflection at large incident angles on both sides of the radome and due to further multiple reflections at an antenna board on which the antennas of the radar system are located, as well as at the surfaces of the radome. The coupling between transmitting and receiving antennas of the radar system introduces additional noise for the signals of the receiving antenna and therefore reduces the performance of the radar system.

[0004] The undesired coupling between a transmitting path and a receiving path of a radar system may particularly be relevant for radar antenna having a wide field of view such as those used in automotive corner radar sensors. The reflectivity of a flat radome increases significantly for high incidence angles at which the corner radar sensors are still transmitting due to their wide field of view. In order to reduce the additional noise level caused by the undesired coupling between transmitting and receiving antennas due to a radome, it has been proposed to include additional absorbers between the transmitting path and the receiving path. However, additional absorbers lead to higher cost of the radar system. Similarly, it has been proposed to implement equivalent band gap structures on an antenna printed circuit board between the transmitting path and the receiving path. However, such structures are sensitive to manufacturing tolerances which may increase scrap rates in mass production of radar systems.

[0005] On the other hand, the undesired coupling between a transmission path and a receiving path of the radar system could be reduced by increasing a horizontal distance between transmitting antennas and receiving antennas, e.g. on a printed circuit board. However, this would increase the entire dimensions of the radar system and therefore lead to additional cost.

[0006] The additional noise level caused by the radome may reduce the sensitivity and the range of a radar system. Due to a reduced sensitivity, weak targets like pedestrians or motorcycles may be erroneously detected at a reduced range by an automotive radar sensor.

[0007] US 2018/0233812 A1 discloses a radar system comprising the features according to the preamble of claim 1.

[0008] US 2018/0132337 A1 discloses a radar system comprising features according to a related technology. However, a recess of a radome is not located outside the respective field of view of transmitting and receiving elements of the radar system.

[0009] US 2018/0159207 A1 also discloses a radar system comprising a radome including multiple layers which have recesses and projections.

[0010] Accordingly, there is a need to provide a radar system in which a noise level caused by a radome is reduced by low efforts and expenses.

SUMMARY

[0011] The present disclosure provides a radar system according to the independent claim. Embodiments are given in the subclaims, the description and the drawings.

[0012] In one aspect, the present disclosure is directed at a radar system comprising a transmitting element adapted to transmit a radar signal, a receiving element adapted to receive a reflected signal of the radar signal being transmitted by the transmitting element, and a radome covering the transmitting element and the receiving element and having an inner surface and an outer surface. The inner surface of the radome faces the transmitting element and the receiving element. The radome comprises a recess being located at the inner surface.

[0013] Due to the recess within the radome, a significant part of radiation which is caused by multiple scattering effects of the radiation of the transmitting element is blocked or redirected. In other words, a part of the energy which would propagate from the transmitting element to the receiving element if no recess were present within the radome is redirected by the recess and does therefore not reach the receiving element.

[0014] Therefore, the transmitting path and the receiving path of the radar system have a reduced coupling due to the recess. This leads to a reduced noise level of the reflected signal which is received by the receiving element. Consequently, the sensitivity of the radar system is improved due to the reduced noise level.

[0015] The transmitting element and the receiving element are located on a base plane and are positioned on a respective side of a plane extending perpendicular to the base plane and intersecting the recess of the radome. In other words, the recess of the radome is located between the transmitting element and the receiving element above a spatial gap between these elements. Due to this position of the recess of the radome, the blocking and redirecting property of the recess for multiply scattered radiation originating from the transmitting element is improved. Since the transmitting element and the receiving element are positioned on different sides of a plane intersecting the recess of the radome, the recess blocks and redirects radiation which would otherwise propagate almost directly from the transmitting element to the receiving element.

[0016] The transmission element has a transmitting field of view into which the radar signal is transmitted, and the receiving element has a receiving field of view from which the reflected signal is received. The recess of the radome is located outside the transmitting field of view and outside the receiving field of view. Due to this, the recess of the radome is not irradiated directly by the radar signal being transmitted by the transmitting element. Therefore, a direct coupling of the transmitting element and the receiving element due to the recess can be avoided. Instead, the efficiency of the recess for reducing multiply scattered radiation reaching the receiving element is enhanced.

[0017] The recess may have a maximized extension between the transmitting field of view and the receiving field of view. Increasing the extension of the recess, e.g. a width parallel to the inner surface of the radome, may further improve the efficiency of the recess when reducing multiply scattered radar signals. However, the extension of the recess is to be restricted such that it does not reach the transmitting field of view or the receiving field of view in order to avoid a direct coupling of the transmitting element and the receiving element.

[0018] The transmitting element and the receiving element may overlap when viewed in a first direction within the base plane. By such an arrangement of the transmitting element and of the receiving element a compact radar system can be achieved which has reduced overall dimensions. When viewed in a second direction being different from the first direction, the transmitting element and the receiving element may be separated by a predetermined distance. The recess of the radome may be located within the predetermined distance above the transmitting element and the receiving element.

[0019] That is, the transmitting element and the receiving element may have a gap between those when viewed in the second direction which may be perpendicular to the first direction, whereas in the first direction an overlap between the transmitting and receiving elements is provided. Due to the location of the recess within the predetermined distance between the transmitting element and the receiving element, the recess decouples the transmitting element and the receiving element without the need of further separating elements like additional absorbers or band gap structures. Therefore, the recess of the radome has a high efficiency for decoupling the receiving element from the transmitting element in compact radar systems in which the transmitting element and the receiving element have an overlapping structure.

[0020] The predetermined distance between the transmitting element and the receiving element may be sufficient in order to avoid a direct reflection of the radar system within the recess in a direction toward the receiving element. Thus, a minimum distance between the transmitting element and the receiving element may be provided in order to prevent a direct coupling of the transmitting and receiving element. On the other hand, this minimum distance required for the decoupling is reduced by the recess of the radome in comparison to radar systems in which no such a recess of the radome is present.

[0021] The transmitting element and the receiving element may be located on a printed circuit board. By the printed circuit board, the base plane for the transmitting element and the receiving element may be uniquely defined. In addition, the printed circuit board may be a standardized and cheap device for accommodating the transmitting and receiving elements. Thus, the cost for the radar system may be reduced by including a standardized printed circuit board.

[0022] According to a further embodiment, the radome may comprise a plate having at least two flat surfaces, and the recess of the radome may be located on one of the flat surfaces of the plate facing the transmitting element and the receiving element. Such a radome having the shape of a flat plate may be easy to manufacture, and in addition the same electrical length may be provided for transmission over incident angles for all parts of the transmitting element.

[0023] A depth of the recess in a direction perpendicular to the flat surfaces of the plate may be not more than a half of a thickness of the plate in the same direction. Due to such a restriction of the depth of the recess, the stability of the plate forming the radome may be ensured.

[0024] The recess may comprise surfaces being inclined with respect to the flat surfaces of the plate. A recess having inclined surfaces may be easier to produce than a corresponding recess having straight surfaces.

[0025] A width of the recess in a direction along one of the flat surfaces may be maximized without contacting a respective field of view of the transmitting element and of the receiving element. Thus, a compromise is achieved between the decoupling of the transmitting and receiving elements by increasing the width of the recess and between avoiding a direct irradiation of the recess by the transmitting element which would counteract the decoupling.

[0026] Furthermore, the radome may comprise the plurality of recesses. If the radome has more than one recess, the decoupling of the transmitting and receiving elements may be enhanced since a greater part of the energy caused by multiple scattering is blocked or redirected.

[0027] The radome may be produced by injection molding including the recess. That is, the recess may be included into a mold before the radome is produced. Due to this, the recess within the radome may be created with negligible additional effort. Alternatively, the recess may be created by milling after producing the radome. In this case, the radome of an existing radar system may additionally be provided with a recess in order to enhance the decoupling between the transmitting and receiving elements.

DRAWINGS

[0028] Exemplary embodiments and functions of the present disclosure are described herein in conjunction with the following drawings, showing schematically:

Fig. 1 depicts a simplified illustration of a radar system according to the prior art,

Fig. 2 depicts a simplified illustration of a radar system according to the disclosure,

Fig. 3 illustrates the effect of decoupling transmitting and receiving elements for the radar system as shown in Fig. 2,

Fig. 4 depicts a perspective view of a radar system according to the disclosure,

Fig. 5 illustrates variations regarding the geometry of a recess within a radome of the radar system according to the disclosure, and

Fig. 6 depicts simulation results for the decoupling of transmitting and receiving elements.

DETAILED DESCRIPTION

[0029] Fig. 1 depicts a simplified illustration of a radar system 11 according to the prior art. The radar system 11 comprises a radome 1 being a straight and flat plate made of plastic. The radar system 11 further comprises a printed circuit board 3 on which transmitting elements or transmitting antennas 4 and receiving elements or receiving antennas 5 are located. The radome 1 is located on top of the printed circuit board 3 in order to cover the transmitting antennas 4 and the receiving antennas 5 and to protect those with respect to the environment, e.g. against dust, moisture, etc.

[0030] The transmitting antennas 4 transmit a radar signal, and a part of this radar signal may be multiply reflected at upper and lower surfaces of the radome 1 and additionally at the surface of the printed circuit board 3. Due to this, a coupling path 7 between one of the transmitting antennas 4 and some of the receiving antennas 5 may be generated. Therefore, a part of the radar signal which is transmitted by the transmitting antenna 4 may arrive at the receiving antennas 5 without being scattered at a target object being located beyond the radome 1.

[0031] Due to the coupling path 7 between the transmitting antennas 4 and the receiving antennas 5, additional noise occurs in a reflected signal being detected by the receiving antennas 5. The enhanced noise level of the reflected signals reduces the sensitivity of the radar system 11.

[0032] Fig. 2 depicts a simplified illustration of a radar system 12 according to the disclosure. The radar system 12 comprises the same elements as the radar system 11 depicted in Fig. 1. In addition, the radome 1 comprises a recess 2 which is located at an inner surface of the radome 1 facing the printed circuit board 3, the transmitting antenna 4 and the receiving antennas 5. The recess 2 is located at a position above a gap on the printed circuit board 3 in which no transmitting antennas 4 and no receiving antennas 5 are positioned. If the upper surface of the printed circuit board 3 is regarded as a base plane on which the transmitting antennas 4 and the receiving antennas 5 are located, the transmitting antennas 4 and the receiving antennas 5 are positioned on a respective side of a further plane extending perpendicular to the base plane, i.e. the printed circuit board 3, and intersecting the recess 2 of the radome 1.

[0033] In addition, a respective field of view 6 is depicted in Fig. 2 for a receiving antenna 4 and a transmitting antenna 5 having the shortest distance with respect to the recess 2 of the radome 1. As shown in Fig. 2, the recess 2 of the radome 1 is located outside the respective field of view 6 of the transmitting antenna 4 and of the receiving antennas 5. Due to this, a direct coupling of one of the transmitting antennas 4 and one of the receiving antennas 5 due to the recess 2 of the radome 1 is excluded.

[0034] Fig. 3 illustrates the effect of the recess 2 within the radome 1 for the radar signals transmitted by the transmitting antennas 4. A part of the radar signal transmitted by the transmitting antennas 4 and being scattered multiple times is redirected by the surfaces of the recess 2 and does therefore not arrive at any of the receiving antennas 5. Therefore, a part of the coupling path 7 as shown in Fig. 1 is transformed to a redirected path 8 due to the recess 2 within the radome 1, as shown in Fig. 3. Therefore, the energy which is transferred by the coupling path 7 from the transmitting antennas 4 to the receiving antennas 5 is strongly reduced due to the redirected path 8. Thus, the noise level of the reflected signal being detected by the receiving antennas 5 is reduced due to the redirected path 8 being created by the recess 2 of the radome 1. Moreover, the sensitivity of the radar system 12 is improved due to the reduced noise level.

[0035] Fig. 4 depicts a perspective view of the radar system 12 according to the disclosure. The radar system 12 comprises the same elements as depicted in Figs. 2 and 3, i.e. a radome 1 covering transmitting antennas 4 and receiving antennas 5 being located on a printed circuit board 3. An arrow 13 additionally indicates the position of the recess 2 being provided on an inner surface of the radome 1. The recess 2 extends parallel to the transmitting and receiving antennas 4, 5 between two longitudinal sides of a housing 14 of the radar system 12. In a direction perpendicular to the extension of the recess 2 within the radome 1 i.e. in a longitudinal direction of the radar system 12, the transmitting antenna 4 and the receiving antenna 5 overlap along a predetermined distance 15. Due to this overlap, the overall dimensions of the radar system 12 can be reduced. On the other hand, the transmitting and receiving antennas 4, 5 have a wide field of view which would reduce a strong coupling path 7 (see Fig. 1) if no recess 2 of the radome 1 were present. Instead, the recess 2 of the radome 1 decouples the receiving antennas 5 from the transmitting antenna 4 as illustrated in Fig. 3 without any need of further separation devices like additional absorbers or bandgap structures.

[0036] In Fig. 5A a portion of the radome 1 is depicted comprising the recess 2. Instead of having straight inner surfaces, i.e. side surfaces extending perpendicular to the inner surface of the radome 1, inclined side surfaces 9 are provided for the recess 2 wherein two different inclination angles are shown. Although it turned out that a variation of the inclination angle of the inclined side surfaces 9 has a low effect on electromagnetic radiation, i.e. on the coupling path 7 and on the redirected path 8 as shown in Fig. 1 and 3, the manufacturing of the radome 1 may be simplified if inclined surfaces 9 are provided.

[0037] As indicated by arrows 10 in Fig. 5B, a width of the recess 2 in a direction parallel to the inner surface of the radome 1 may be varied. It turned out that the width of the recess 2 in a direction parallel to the inner surface of the radome 1 has a strong influence on the decoupling of the transmitting and receiving antenna 4, 5 (see Fig. 2 and 3). The same holds true for the depth of the recess 2 in a direction perpendicular to the inner surface of the radome 1. Therefore, the width and the depth of the recess 2 is an important design parameter for the radome 1. It should be noted, however, that the extension of the width and the depth of the recess 2 within the radome 1 is restricted by the field of view 6 of the transmitting and receiving antennas 4, 5, as shown in Fig. 2. That is, the maximum width and maximum depth of the recess 2 within the radome 1 are limited such that a contact or overlap of the recess 2 with the fields of view 6 of the transmitting and receiving antennas 4, 5 is avoided.

[0038] Fig. 6 depicts simulation results for antenna decoupling or antenna isolation, i.e. for decoupling of the transmitting antennas 4 and the receiving antennas 5 as shown in Fig. 2. The antenna isolation in dB is depicted on the vertical axis, whereas the frequency in GHz is depicted on the horizontal axis. For this simulation, the strongest coupling paths between the transmitting antennas 4 and the receiving antennas 5 were considered only.

[0039] In detail, the full lines 21 and 22 represent the coupling paths between the first transmitting antenna 4 on the right side in Figs. 2 to 4 and the receiving antenna 5 being closest to the transmitting antennas 4, i.e. for the third antenna of the system when starting from the right side. Furthermore, the dashed curves 23 and 24 show the antenna isolation for the second transmitting antenna 4 and the closest receiving antenna 5, i.e. for the antenna elements 4, 5 being closest to each other (see Figs. 2 to 4). Furthermore, the lines 21 and 23 show simulation results for a radar system 11 according to the prior art as shown in Fig. 1 and having a radome 1 without the recess 2. In contrast, the lines 22 and 24 show simulation results for a radar system 12 according to the disclosure as shown in Fig. 2 to 4 and comprising a radome 1 having the recess 2 for improving the decoupling between the transmitting and receiving antenna. As can be easily recognized from Fig. 6, the curves 21 and 23 for the radar system 11 comprising no recess 2 within the radome 1 show a weaker decoupling or isolation between the antennas for all frequencies than the curves 22, 24 for the radar system 12 having the recess 2 within the radome 1. At a frequency of 76.5 GHz being used for typical operation of the radar system 12 as shown in Fig. 4, an improvement of the isolation between the transmitting and receiving antennas of about 4 dB is achieved due to the presence of the recess 2 within the radome 1. In summary, the simulation results show that the recess 2 of the radome 1 is a cheap and effective measure to improve the decoupling or isolation of the transmitting antennas 4 and the receiving antennas 5.

Reference numeral list

[0040]

1	radome
2	recess
3	printed circuit board
4	transmitting antenna
5	receiving antenna
6	field of view
7	coupling path
8	redirected path
9	inclined inner surface of the recess
10	arrow
11, 12	radar system
13	arrow
14	housing
15	overlap distance
21	antenna isolation for first and third antennas without recess
22	antenna isolation for first and third antennas with recess
23	antenna isolation for second and third antennas without recess
24	antenna isolation for second and third antennas with recess

Claims

1. Radar system (12), comprising:

   a transmitting element (4) adapted to transmit a radar signal,
   a receiving element (5) adapted to receive a reflected signal of the radar signal being transmitted by the transmitting element (4),
   a radome (1) covering the transmitting element

(4) and the receiving element (5) and having an inner surface and an outer surface,
wherein the inner surface of the radome (1) faces the transmitting element (4) and the receiving element (5),
wherein the radome (1) comprises a recess (2) being located at the inner surface, and
wherein the transmitting element (4) has a transmitting field of view (6) into which the radar signal is transmitted and the receiving element (5) has a receiving field of view (6) from which the reflected signal is received,
wherein the recess (2) of the radome (1) is located outside the transmitting field of view (6) and outside the receiving field of view (6), and
wherein the transmitting element (4) and the receiving element (5) are located on a base plane, and wherein
the transmitting element (4) and the receiving element (5) are positioned on a respective side of a plane extending perpendicular to the base plane and intersecting the recess (2) of the radome (1).

2. Radar system (12) according to claim 1, wherein the recess (2) has a maximized extension between the transmitting field of view (6) and the receiving field of view (6).

3. Radar system (12) according to claim 1 or 2, wherein: the transmitting element (4) and receiving element (5) overlap when viewed in a first direction within the base plane.

4. Radar system (12) according to claim 3, wherein

when viewed in a second direction being different from the first direction, the transmitting element (4) and the receiving element (5) are separated by a predetermined distance, and
the recess (2) of the radome (1) is located within the predetermined distance above the transmitting element (4) and the receiving element (5).

5. Radar system (12) according to claim 4, wherein the predetermined distance between the transmitting element (4) and the receiving element (5) is sufficient in order to avoid a direct reflection of the radar signal within the recess (2) in a direction toward the receiving element (5).

6. Radar system (12) according to anyone of the preceding claims, wherein the transmitting element (4) and the receiving element (5) are located on a printed circuit board (3).

7. Radar system (12) according to anyone of the preceding claims, wherein:

the radome (1) comprises a plate having at least two flat surfaces including the inner surface and the outer surface,
the recess (2) of the radome (1) is located on the inner surface of the plate facing the transmitting element (4) and the receiving element (5).

8. Radar system (12) according to claim 7, wherein a depth of the recess (2) in a direction perpendicular to the flat surfaces of the plate is not more than half of a thickness of the plate in the same direction.

9. Radar system (12) according to claim 7 or 8, wherein the recess (2) comprises surfaces (9) being inclined with respect to the flat surfaces of the plate.

10. Radar system (12) according to anyone of the preceding claims, wherein:
the radome (1) comprises a plurality of recesses (2).

11. Radar system (12) according to anyone of the preceding claims, wherein:
the radome (1) is produced by injection molding including the recess (2).

12. Radar system (12) according to anyone of claims 1 to 10, wherein:
the recess (2) is created by milling after producing the radome (1).

Patentansprüche

1. Radarsystem (12), umfassend:

ein Sendeelement (4), das ausgebildet ist, um ein Radarsignal zu senden,
ein Empfangselement (5), das ausgebildet ist, um ein reflektiertes Signal des Radarsignals zu empfangen, das von dem Sendeelement (4) gesendet wird,
ein Radom (1), welches das Sendeelement (4) und das Empfangselement (5) abdeckt und eine Innenfläche sowie eine Außenfläche aufweist,
wobei die Innenfläche des Radoms (1) dem Sendeelement (4) und dem Empfangselement (5) zugewandt ist,
wobei das Radom (1) eine Aussparung (2) umfasst, die an der Innenfläche angeordnet ist, und
wobei das Sendeelement (4) ein Sendesichtfeld (6) aufweist, in welches das Radarsignal gesendet wird, und das Empfangselement (5) ein Empfangssichtfeld (6) aufweist, aus dem das reflektierte Signal empfangen wird,
wobei die Aussparung (2) des Radoms (1) außerhalb des Sendesichtfelds (6) und außerhalb des Empfangssichtfelds (6) angeordnet ist,

wobei das Sendeelement (4) und das Empfangselement (5) auf einer Basisebene angeordnet sind und

wobei das Sendeelement (4) und das Empfangselement (5) auf einer jeweiligen Seite einer Ebene positioniert sind, die sich rechtwinklig zu der Basisebene erstreckt und die Aussparung (2) des Radoms (1) schneidet.

2. Radarsystem (12) nach Anspruch 1, wobei die Aussparung (2) eine maximierte Ausdehnung zwischen dem Sendesichtfeld (6) und dem Empfangssichtfeld (6) aufweist.

3. Radarsystem (12) nach Anspruch 1 oder 2, wobei: sich das Sendeelement (4) und das Empfangselement (5) überlagern, wenn diese in einer ersten Richtung innerhalb der Basisebene betrachtet werden.

4. Radarsystem (12) nach Anspruch 3, wobei

das Sendeelement (4) und das Empfangselement (5) dann, wenn diese in einer zweiten Richtung betrachtet werden, die von der ersten Richtung verschieden ist, um eine vorbestimmte Distanz voneinander separiert sind und

die Aussparung (2) des Radoms (1) innerhalb der vorbestimmten Distanz oberhalb des Sendeelements (4) und des Empfangselements (5) angeordnet ist.

5. Radarsystem (12) nach Anspruch 4, wobei die vorbestimmte Distanz zwischen dem Sendeelement (4) und dem Empfangselement (5) ausreichend ist, um eine direkte Reflexion des Radarsignals innerhalb der Aussparung (2) in einer Richtung zu dem Empfangselement (5) hin zu vermeiden.

6. Radarsystem (12) nach einem der vorstehenden Ansprüche, wobei das Sendeelement (4) und das Empfangselement (5) auf einer Leiterplatte (3) angeordnet sind.

7. Radarsystem (12) nach einem der vorstehenden Ansprüche, wobei:

das Radom (1) eine Platte umfasst, die zumindest zwei ebene Oberflächen aufweist, welche die Innenfläche und die Außenfläche umfassen,

die Aussparung (2) des Radoms (1) an der Innenfläche der Platte angeordnet ist, welche dem Sendeelement (4) und dem Empfangselement (5) zugewandt ist.

8. Radarsystem (12) nach Anspruch 7, wobei eine Tiefe der Aussparung (2) in einer Richtung rechtwinklig zu den flachen Oberflächen der Platte nicht größer als die Hälfte einer Dicke der Platte in der gleichen Richtung ist.

9. Radarsystem (12) nach Anspruch 7 oder 8, wobei die Aussparung (2) Oberflächen (9) umfasst, die bezogen auf die flachen Oberflächen der Platte geneigt sind.

10. Radarsystem (12) nach einem der vorstehenden Ansprüche, wobei: das Radom (1) mehrere Aussparungen (2) umfasst.

11. Radarsystem (12) nach einem der vorstehenden Ansprüche, wobei: das Radom (1) durch Spritzgießen hergestellt ist, welches die Aussparung (2) umfasst.

12. Radarsystem (12) nach einem der Ansprüche 1 bis 10, wobei: die Aussparung (2) nach der Herstellung des Radoms (1) durch Fräsen gebildet ist.

Revendications

1. Système radar (12), comprenant :

un élément émetteur (4) adapté pour émettre un signal radar,

un élément récepteur (5) adapté pour recevoir un signal réfléchi du signal radar qui est émis par l'élément émetteur (4),

un radôme (1) qui couvre l'élément émetteur (4) et l'élément récepteur (5) et qui a une surface intérieure et une surface extérieure,

dans lequel la surface intérieure du radôme (1) fait face à l'élément émetteur (4) et à l'élément récepteur (5),

dans lequel le radôme (1) comprend un évidement (2) qui est situé au niveau de la surface intérieure, et

dans lequel l'élément émetteur (4) a un champ de vision (6) d'émission dans jusque dans lequel le signal radar est émis et l'élément récepteur (5) a un champ de vision (6) de réception depuis lequel le signal réfléchi est reçu,

dans lequel l'évidement (2) du radôme (1) est situé à l'extérieur du champ de vision (6) d'émission et à l'extérieur du champ de vision (6) de réception,

dans lequel l'élément émetteur (4) et l'élément récepteur (5) sont situés sur un plan de base,

et dans lequel l'élément émetteur (4) et l'élément récepteur (5) sont positionnés sur un côté respectif d'un plan s'étendant perpendiculairement au plan de base et recoupant l'évidement (2) du radôme (1).

2. Système radar (12) selon la revendication 1, dans lequel l'évidement (2) a une extension maximisée entre le champ de vision (6) d'émission et le champ de vision (6) de réception.

3. Système radar (12) selon la revendication 1 ou 2, dans lequel :
l'élément émetteur (4) et l'élément récepteur (5) se chevauchent quand ils sont vus dans une première direction à l'intérieur du plan de base.

4. Système radar (12) selon la revendication 3, dans lequel

quand ils sont vus dans une seconde direction qui est différente de la première direction, l'élément émetteur (4) et l'élément récepteur (5) sont séparés à raison d'une distance prédéterminée, et
l'évidement (2) du radôme (1) est situé à l'intérieur de la distance prédéterminée au-dessus de l'élément émetteur (4) et de l'élément récepteur (5).

5. Système radar (12) selon la revendication 4, dans lequel
la distance prédéterminée entre l'élément émetteur (4) et l'élément récepteur (5) est suffisante pour éviter une réflexion directe du signal radar à l'intérieur de l'évidement (2) dans une direction vers l'élément récepteur (5).

6. Système radar (12) selon l'une quelconque des revendications précédentes, dans lequel
l'élément émetteur (4) et l'élément récepteur (5) sont situés sur une carte à circuit imprimé (3).

7. Système radar (12) selon l'une quelconque des revendications précédentes, dans lequel :

le radôme (1) comprend une plaque qui a au moins deux surfaces plates incluant la surface intérieure et la surface extérieure,
l'évidement (2) du radôme (1) est situé sur la surface intérieure de la plaque en vis-à-vis de l'élément émetteur (4) et de l'élément récepteur (5).

8. Système radar (12) selon la revendication 7, dans lequel
une profondeur de l'évidement (2) dans une direction perpendiculaire aux surfaces plates de la plaque n'est pas supérieure à la moitié d'une épaisseur de la plaque dans la même direction.

9. Système radar (12) selon la revendication 7 ou 8, dans lequel
l'évidement (2) comprend des surfaces (9) qui sont inclinées par rapport aux surfaces plates de la plaque.

10. Système radar (12) selon l'une quelconque des revendications précédentes, dans lequel :
le radôme (1) comprend une pluralité d'évidements (2).

11. Système radar (12) selon l'une quelconque des revendications précédentes, dans lequel :
le radôme (1) est produit par moulage par injection qui inclut l'évidement (2).

12. Système radar (12) selon l'une quelconque des revendications 1 à 10, dans lequel :
l'évidement (2) est créé par fraisage après production du radôme (1).

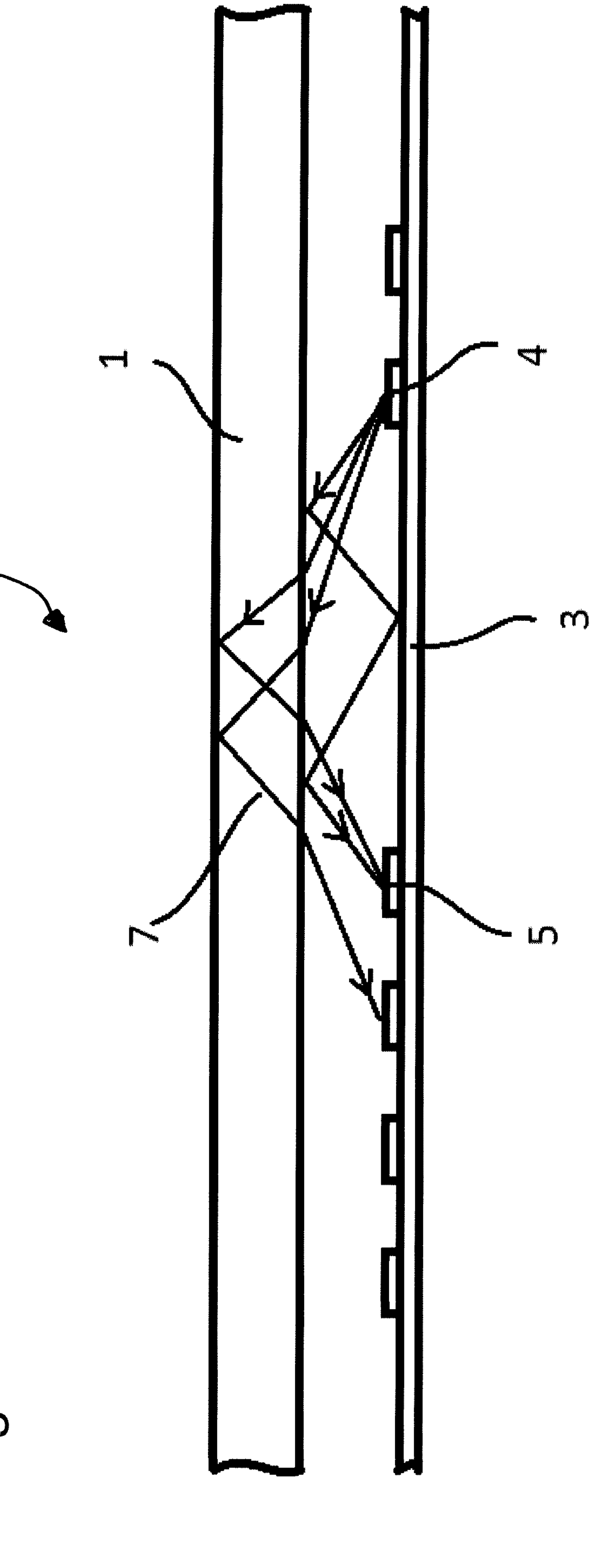

Fig. 1

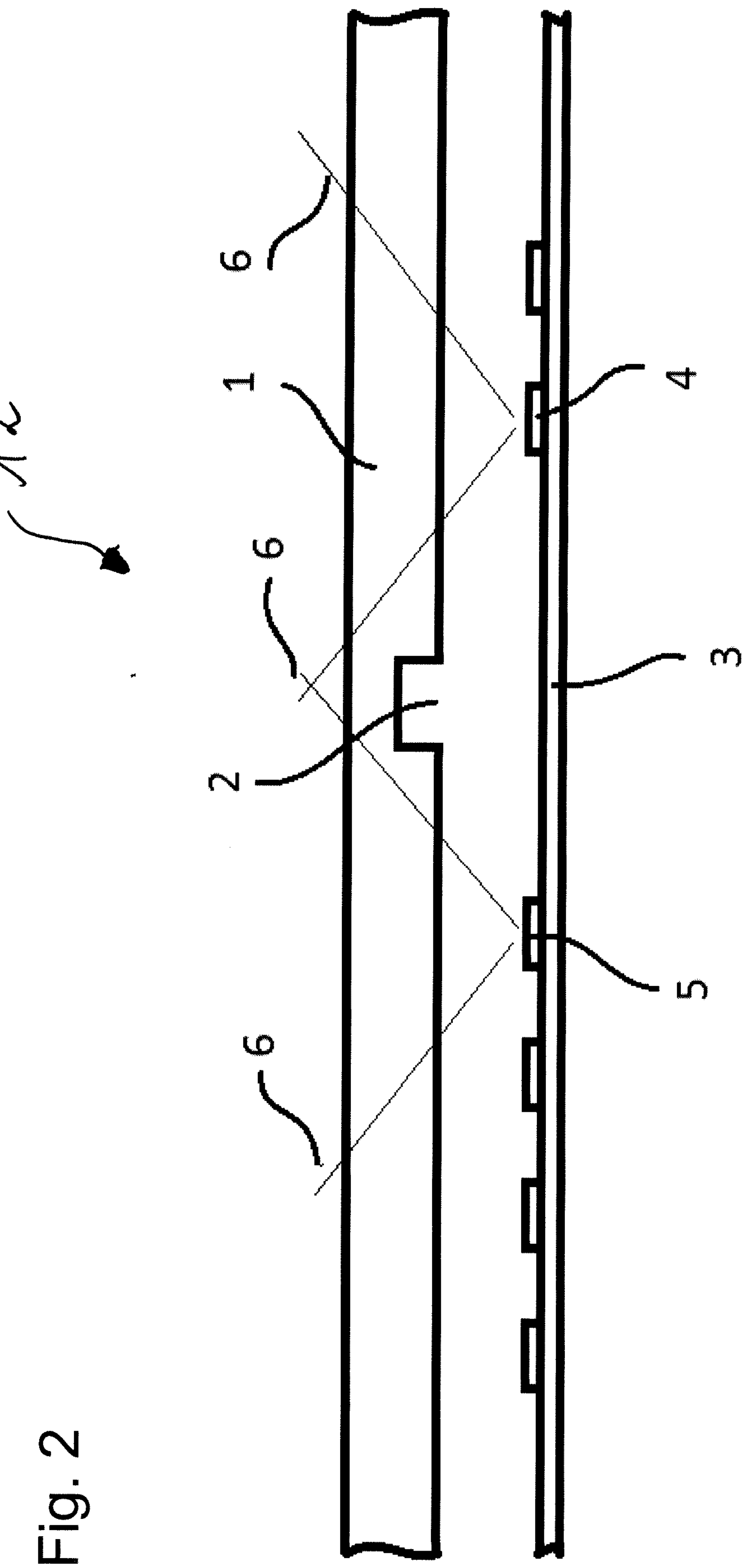

Fig. 2

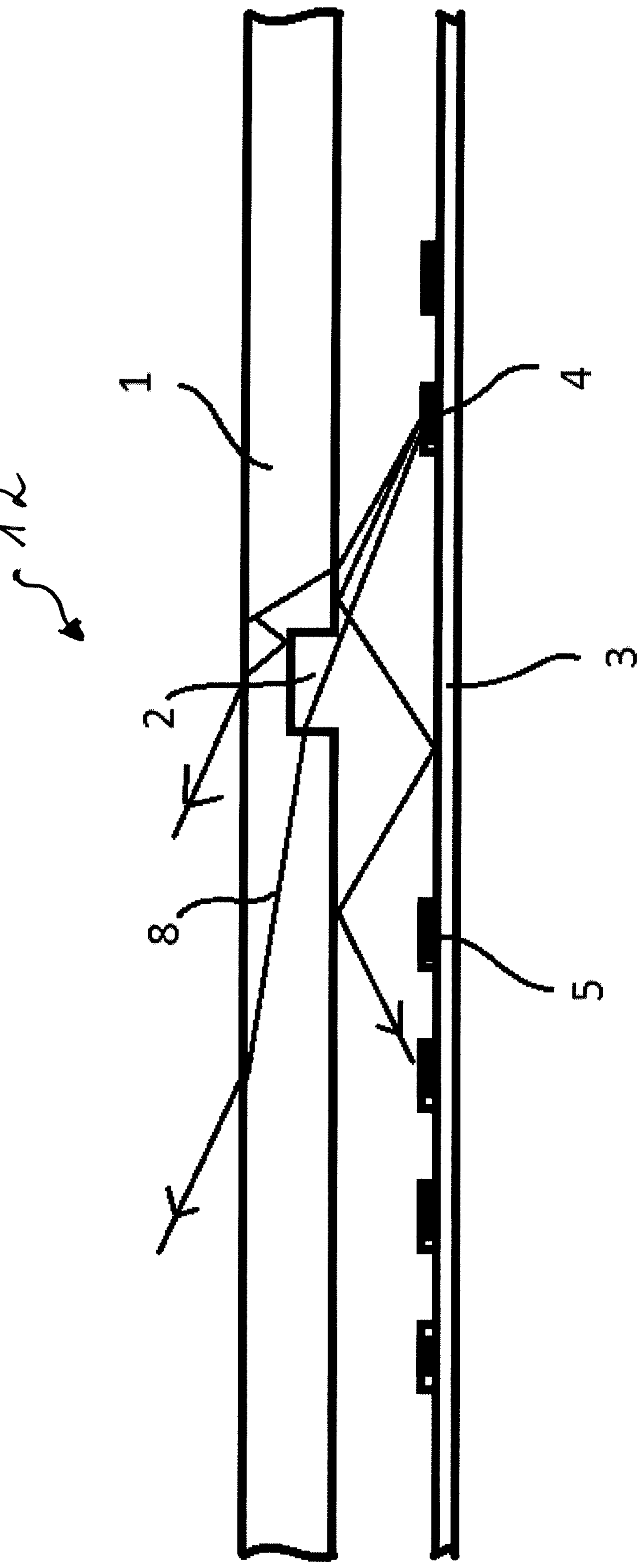

Fig. 3

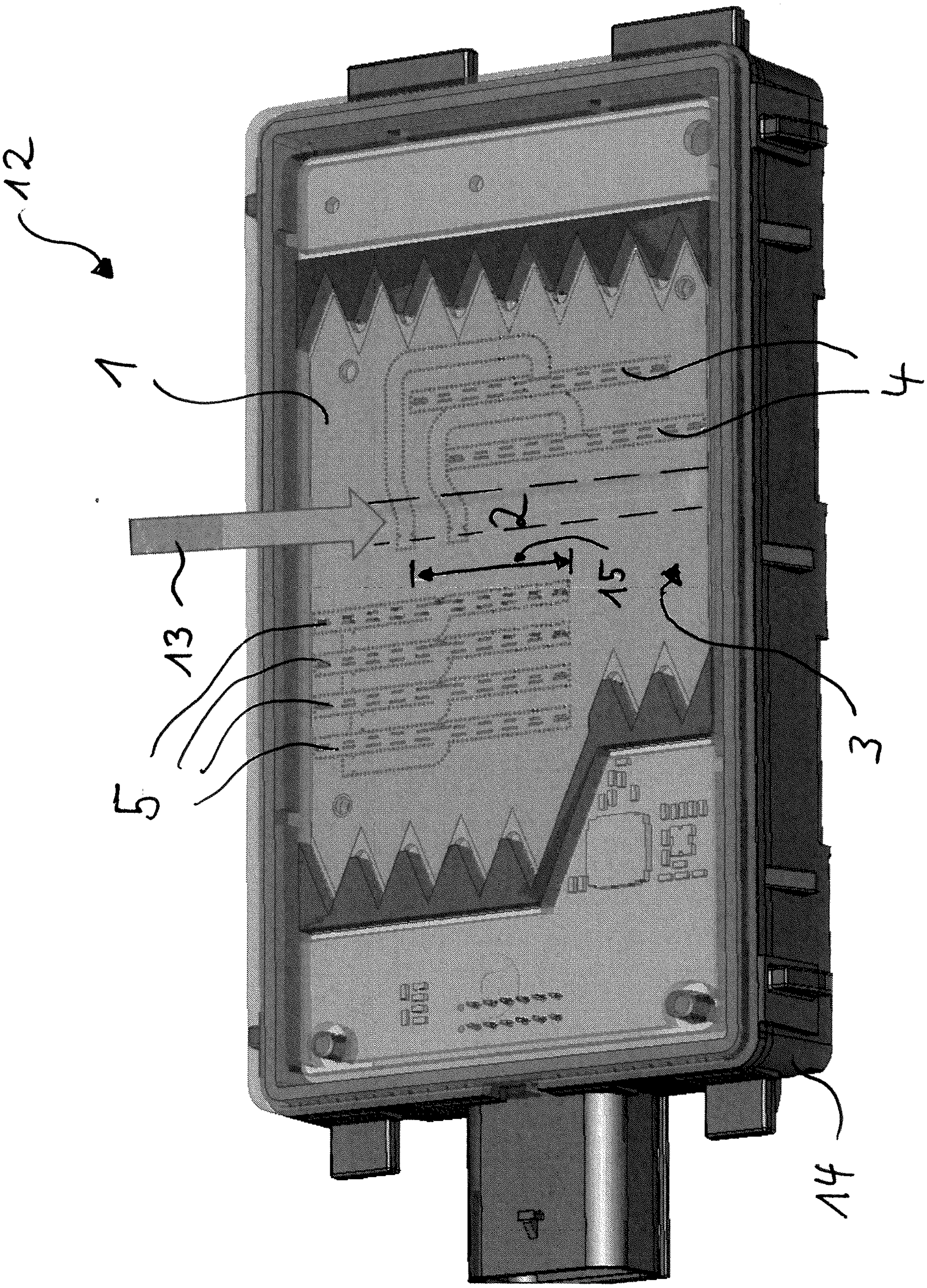

Fig. 4

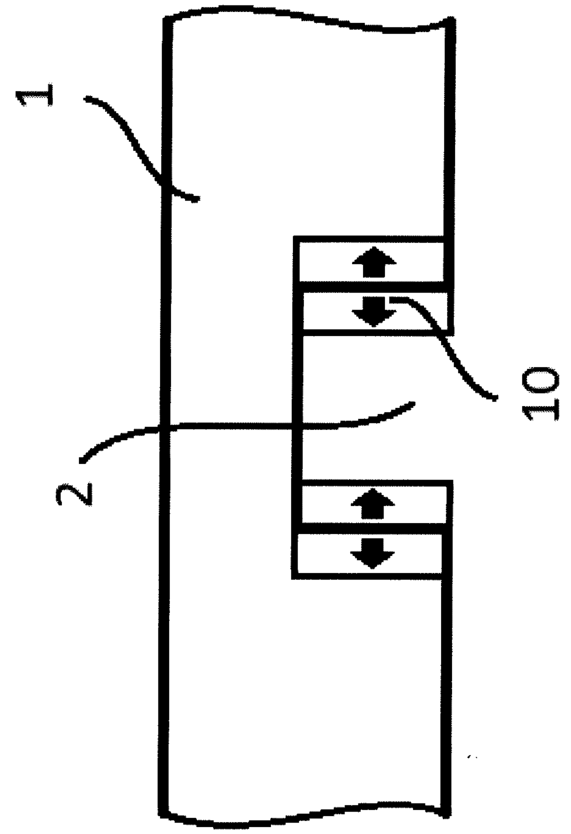

Fig. 5B

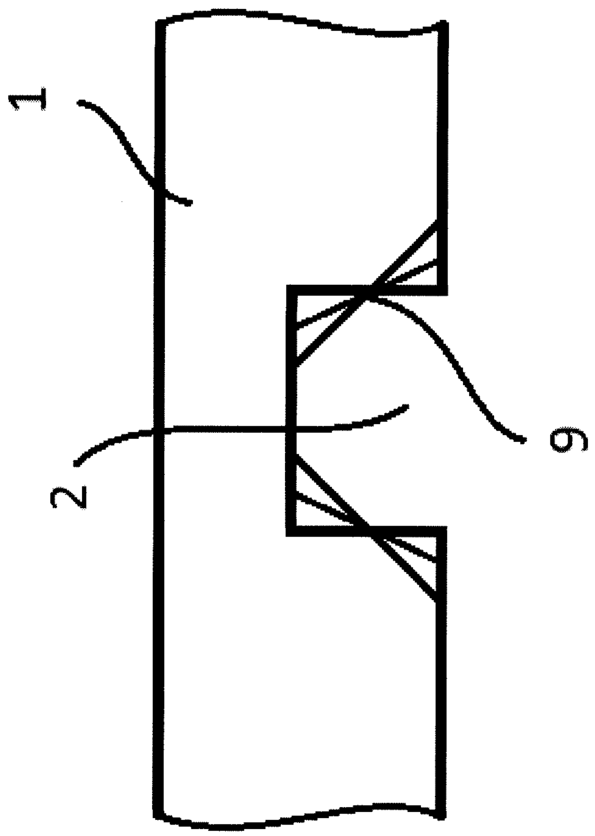

Fig. 5A

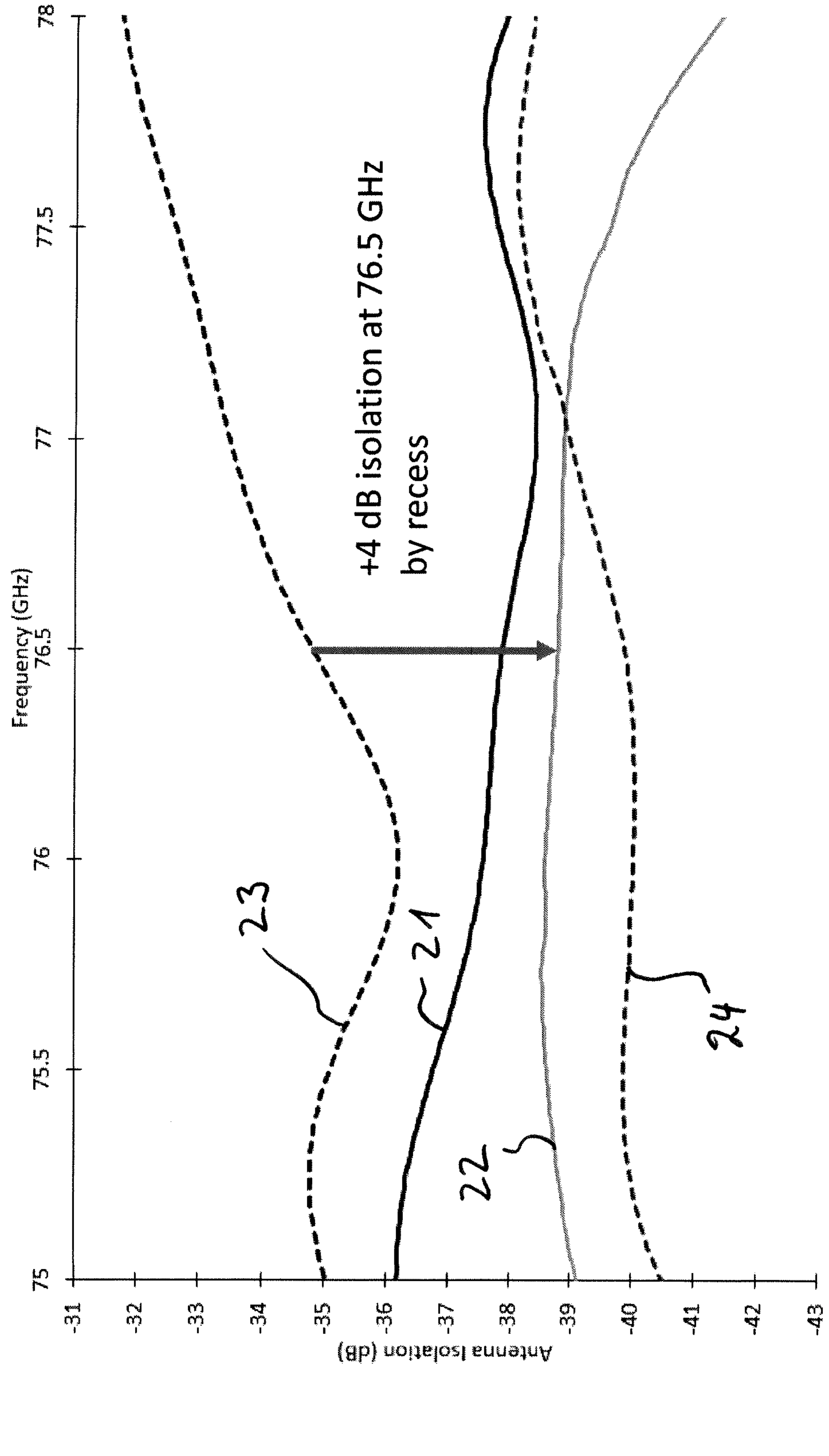
+4 dB isolation at 76.5 GHz
by recess
Frequency (GHz)
Antenna Isolation (dB)
75
75.5
76
76.5
77
77.5
78
-31
-32
-33
-34
-35
-36
-37
-38
-39
-40
-41
-42
-43
21
22
23
24

Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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